

CLAIMS

1. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a flexible wall and an exit port sealably communicating
5 with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the apparatus comprising:

a centrifuge rotor having a round centrifuge chamber of selected volume, the centrifuge rotor being controllably rotatable around a central axis by a motor mechanism;

a round expandable enclosure disposed within the centrifuge chamber having a rotation axis
10 coincident with the central rotation axis and a flexible wall, the fluid container having a rotation axis and being coaxially receivable within the centrifuge chamber, the expandable enclosure being sealably connected to a source of an expresser fluid which has a density selected to be greater than the density of each of the selected one or more fluid materials disposed in the fluid container;

a pump for controllably pumping a selected volume of the expresser fluid into and out of the
15 expandable enclosure wherein the fluid container is receivable within the centrifuge chamber;

a retaining mechanism for holding the fluid container within the centrifuge chamber in a coaxial position wherein the flexible wall of the fluid container is in contact with the flexible wall of the expandable enclosure.

20 2. The apparatus of claim 1 wherein the expandable enclosure comprises a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into

a first chamber for receiving the fluid container and a second fluid sealed chamber for receiving the expresser fluid.

3. The apparatus of claim 1 wherein the flexible wall of the expandable enclosure comprises
5 an elastomeric sheet material.

4. The apparatus of claim 1 further comprising a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid.

10 5. The apparatus of claim 1 wherein the fluid container has a first radius and the second fluid sealed chamber has a second radius which is at least equal to the first radius of the fluid container, wherein the expresser fluid pumped into the second fluid sealed chamber travels to a circumferential position within the second fluid sealed chamber which is more radially outward from the central axis than a circumferential position to which the one or more selected fluid materials in the fluid container
15 travel when the rotor is drivably rotated around the central axis.

6. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a rotation axis, a flexible wall and an exit port sealably
20 communicating with the container for enabling the selected fluid materials contained therein to be expressed out of the container through the exit port, the apparatus comprising:

a centrifuge rotor having a round centrifuge chamber, the centrifuge rotor being controllably rotatable around a central axis by a motor mechanism:

a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into a first chamber for receiving the fluid container coaxially with the central rotation axis
5 and a second round fluid sealed chamber having a rotation axis coincident with the central axis for receiving an expresser fluid, wherein the expresser fluid has a density selected to be greater than the density of each of the selected one or more fluid materials disposed in the container:

a pump for controllably pumping a selected volume of the expresser fluid into and out of the second fluid sealed centrifuge chamber:

10 a retaining mechanism for holding the container within the first chamber in a position wherein the flexible wall of the container is in contact with an outside surface of the flexible membrane.

7. The apparatus of claim 6 wherein the flexible membrane comprises an elastomeric sheet material.

15 8. The apparatus of claim 6 further comprising a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid.

9. The apparatus of claim 6 wherein the fluid container has a first radius and the second
20 fluid sealed chamber has a second radius which is at least equal to the first radius of the fluid container, wherein the expresser fluid pumped into the second fluid sealed chamber travels to a circumferential position within the second fluid sealed chamber which is more radially outward from the central axis

than a circumferential position to which the one or more selected fluid materials in the fluid container travel when the rotor is drivably rotated around the central axis.

10. In a centrifuge apparatus comprising a rotor having a centrifuge chamber which is
5 controllably rotatable around a central axis, a method for expressing one or more selected fluid materials each having a selected density out of a fluid container which contains the selected fluid materials wherein the fluid container comprises a round enclosure having a radius, a rotation axis, a flexible wall and an exit port sealably communicating with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the method comprising:

10 forming a round expandable enclosure within the centrifuge chamber wherein the expandable enclosure has a flexible wall, a radius and a rotation axis coincident with the central axis of the rotor;

mounting the fluid container coaxially within the centrifuge chamber such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure;

15 selecting an expresser fluid having a density greater than the density of each of the selected fluid materials;

pumping the selected expresser fluid into the expandable enclosure in an amount sufficient to expand the expandable enclosure such that the flexible wall of the expandable enclosure contacts the flexible wall of the fluid container; and,

20 drivably rotating the rotor around the central axis before, during or after the step of pumping.

11. The method of claim 10 wherein the radius of the expandable enclosure is selected to be at least equal to the radius of the fluid container.

12. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a flexible wall and an exit port sealably communicating
5 with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the apparatus comprising:

a separation housing having a round chamber of selected volume, the housing having a central axis;

a round expandable enclosure disposed within the round chamber having an axis coincident with
10 the central axis of the separation chamber and a flexible wall, the fluid container having an axis and being coaxially receivable within the round chamber, the expandable enclosure being sealably connected to a source of an expresser fluid which has a density selected to be greater than the density of each of the selected one or more fluid materials disposed in the fluid container;

a pump for controllably pumping a selected volume of the expresser fluid into and out of the
15 expandable enclosure wherein the fluid container is receivable within the round chamber;

a retaining mechanism for holding the fluid container within the round chamber in a coaxial position wherein the flexible wall of the fluid container is in contact with the flexible wall of the expandable enclosure.

20 13. The apparatus of claim 12 wherein the expandable enclosure comprises a flexible membrane sealably attached to a surface of the separation housing such that the round chamber is

divided into a first chamber for receiving the fluid container and a second fluid sealed chamber for receiving the expresser fluid.

14. The apparatus of claim 12 wherein the flexible wall of the expandable enclosure
5 comprises an elastomeric sheet material.

15. The apparatus of claim 12 wherein the fluid container has a first radius and the
expandable enclosure has a second radius which is at least equal to the first radius of the fluid container.

10 16. The apparatus of claim 12 further comprising a heater mechanism having a control
mechanism for selectively controlling the temperature of the expresser fluid.

17. Apparatus for selectively expressing one or more selected fluid materials out of a fluid
15 container, wherein each of the selected fluid materials has a selected density and wherein the fluid
container comprises a round enclosure having a flexible wall and an exit port sealably communicating
with the fluid container for enabling the selected fluid materials contained therein to be expressed out
of the fluid container through the exit port, the apparatus comprising:

a centrifuge rotor having a round centrifuge chamber of selected volume, the centrifuge rotor
20 being controllably rotatable around a central axis by a motor mechanism;

a round expandable enclosure disposed within the centrifuge chamber having a rotation axis
coincident with the central rotation axis and a flexible wall, the fluid container having a rotation axis

and being coaxially receivable within the centrifuge chamber, the expandable enclosure being sealably connected to a source of an expresser fluid:

a pump for controllably pumping a selected volume of the expresser fluid into and out of the expandable enclosure;

5 wherein the fluid container has a flexible wall and is receivable within the centrifuge chamber such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure:

a mechanism for filling the fluid container with any preselected variable volume of the one or more selected fluid materials which is less than the selected volume of the centrifuge chamber;

a retaining mechanism for holding the fluid container completely within the centrifuge chamber
10 upon expansion of the expandable enclosure.

18. The apparatus of claim 17 wherein the expandable enclosure comprises a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into a first chamber for receiving the fluid container and a second fluid sealed chamber for receiving the
15 expresser fluid.

19. The apparatus of claim 17 wherein the flexible wall of the expandable enclosure comprises an elastomeric sheet material.

20. The apparatus of claim 17 wherein the expresser fluid has a density selected to be greater
20 than the density of each of the selected one or more fluid materials disposed in the fluid container;

21. The apparatus of claim 17 wherein the fluid container has a first radius and the expandable enclosure has a second radius which is at least equal to the first radius of the fluid container, wherein the expresser fluid pumped into the expandable enclosure travels to a circumferential position within the expandable enclosure which is more radially outward from the central axis than a circumferential position to which the one or more selected fluid materials in the fluid container travel when the rotor is drivably rotated around the central axis.

22. The apparatus of claim 17 further comprising a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid.

23. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a rotation axis, a flexible wall and an exit port sealably communicating with the container for enabling the selected fluid materials contained therein to be expressed out of the container through the exit port, the apparatus comprising:

a centrifuge rotor having a round centrifuge chamber of selected volume, the centrifuge rotor being controllably rotatable around a central axis by a motor mechanism:

a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into a first chamber for receiving the fluid container coaxially with the central rotation axis and a second round fluid sealed chamber having a rotation axis coincident with the central axis for receiving an expresser fluid:

a pump for controllably pumping a selected volume of the expresser fluid into and out of the second fluid sealed centrifuge chamber:

wherein the fluid container has a flexible wall and is receivable within the centrifuge chamber
5 such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure:

a mechanism for filling the fluid container with any preselected variable volume of the one or more selected fluid materials which is less than the selected volume of the centrifuge chamber:

a retaining mechanism for holding the fluid container completely within the centrifuge chamber upon expansion of the expandable enclosure.

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24. The apparatus of claim 23 wherein the flexible membrane comprises an elastomeric sheet material.

25. The apparatus of claim 23 wherein the expresser fluid has a density selected to be greater
15 than the density of each of the selected one or more fluid materials disposed in the fluid container:

26. The apparatus of claim 23 wherein the fluid container has a first radius and the second fluid sealed chamber has a second radius which is at least equal to the first radius of the fluid container, wherein the expresser fluid pumped into the second fluid sealed chamber travels to a circumferential
20 position within the second fluid sealed chamber which is more radially outward from the central axis than a circumferential position to which the one or more selected fluid materials in the fluid container travel when the rotor is drivably rotated around the central axis.

27. The apparatus of claim 23 further comprising a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid.

28. In a centrifuge apparatus comprising a rotor having a centrifuge chamber of a selected
5 volume which is controllably rotatable around a central axis, a method for expressing one or more selected fluid materials each having a selected density out of a fluid container which contains the selected fluid materials wherein the fluid container comprises a round enclosure having a rotation axis, a flexible wall and an exit port sealably communicating with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the
10 method comprising:

forming a round expandable enclosure within the centrifuge chamber wherein the expandable enclosure has a flexible wall and a rotation axis coincident with the central axis of the rotor;

mounting the fluid container coaxially within the centrifuge chamber such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure;

15 filling the fluid container with any preselected variable volume of the one or more of the selected fluid materials which is less than the selected volume of the centrifuge chamber before, during or after the step of mounting;

pumping a selected expresser fluid into the expandable enclosure in an amount sufficient to expand the expandable enclosure such that the flexible wall of the expandable enclosure contacts the
20 flexible wall of the fluid container;

holding the fluid container completely within the centrifuge chamber during the step pumping and,

drivably rotating the rotor around the central axis before or during the step of pumping.

29. The method of claim 28 wherein the step of pumping includes preselecting the expresser fluid to have a density greater than the density of each of the selected fluid materials.

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30. The method of claim 28 further comprising placing the expresser fluid at one or more selected temperatures prior to or during the step of pumping.

31. In a centrifuge apparatus comprising a rotor having a centrifuge chamber of a selected
10 volume which is controllably rotatable around a central axis, a method for consistently processing a selected biological cell material between separate processing cycles in the centrifuge apparatus, the method comprising:

selecting a fluid material having a predetermined composition for treatment of the selected biological cell material:

15 forming a round expandable enclosure within the centrifuge chamber wherein the expandable enclosure has a flexible wall and a rotation axis coincident with the central axis of the rotor:

mounting a round fluid container having rotation axis, a flexible wall and an exit port sealably communicating with the fluid container coaxially within the centrifuge chamber such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure:

20 filling the fluid container with a volume of the selected biological cells and a volume of the selected fluid material in a predetermined ratio before, during or after the step of mounting:

pumping a selected expresser fluid into the expandable enclosure in an amount sufficient to expand the expandable enclosure such that the flexible wall of the expandable enclosure contacts the flexible wall of the fluid container;

holding the fluid container completely within the centrifuge chamber during the step pumping;

5 drivably rotating the rotor around the central axis before or during the step of pumping; and,

repeating the steps of mounting, filling, pumping, holding and drivably rotating at least once.

32. The method of claim 31 wherein the step of pumping includes preselecting the expresser fluid to have a density greater than the density of the selected biological cell material and the selected
10 fluid material.

33. The method of claim 31 further comprising placing the expresser fluid at one or more selected temperatures prior to or during the step of pumping.

15 34. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a flexible wall and an exit port sealably communicating with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the apparatus comprising:

20 a centrifuge rotor having a round centrifuge chamber of selected volume, the centrifuge rotor being controllably rotatable around a central axis by a motor mechanism;

a round expandable enclosure disposed within the centrifuge chamber having a rotation axis coincident with the central rotation axis and a flexible wall, the fluid container having a rotation axis and being coaxially receivable within the centrifuge chamber, the expandable enclosure being sealably connected to a source of an expresser fluid;

5 a pump for controllably pumping a selected volume of the expresser fluid into and out of the expandable enclosure wherein the fluid container is receivable within the centrifuge chamber;

a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid;

a retaining mechanism for holding the fluid container within the first chamber in a coaxial
10 position wherein the flexible wall of the fluid container is in contact with the flexible wall of the fluid container.

35. The apparatus of claim 34 wherein the control mechanism includes a program for automatically controlling the temperature of the expresser fluid.

15 36. The apparatus of claim 34 wherein the expandable enclosure comprises a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into a first chamber for receiving the fluid container and a second fluid sealed chamber for receiving the expresser fluid.

20 37. The apparatus of claim 34 wherein the flexible wall of the expandable enclosure comprises an elastomeric sheet material.

38. The apparatus of claim 34 wherein the expresser fluid has a density selected to be greater than the density of each of the selected one or more fluid materials disposed in the container.

39. The apparatus of claim 34 wherein the fluid container has a first radius and the second fluid sealed chamber has a second radius which is at least equal to the first radius of the fluid container. wherein the expresser fluid pumped into the second fluid sealed chamber travels to a circumferential position within the second fluid sealed chamber which is more radially outward from the central axis than a circumferential position to which the one or more selected fluid materials in the fluid container travel when the rotor is drivably rotated around the central axis.

40. Apparatus for selectively expressing one or more selected fluid materials out of a fluid container, wherein each of the selected fluid materials has a selected density and wherein the fluid container comprises a round enclosure having a rotation axis, a flexible wall and an exit port sealably communicating with the container for enabling the selected fluid materials contained therein to be expressed out of the container through the exit port, the apparatus comprising:

a centrifuge rotor having a round centrifuge chamber, the centrifuge rotor being controllably rotatable around a central axis by a motor mechanism:

a flexible membrane sealably attached to a surface of the rotor such that the centrifuge chamber is divided into a first chamber for receiving the fluid container coaxially with the central rotation axis and a second round fluid sealed chamber having a rotation axis coincident with the central axis for receiving an expresser fluid:

a pump for controllably pumping a selected volume of the expresser fluid into and out of the second fluid sealed centrifuge chamber:

a heater mechanism having a control mechanism for selectively controlling the temperature of the expresser fluid;

5 a retaining mechanism for holding the container within the first chamber in a position wherein the flexible wall of the container is in contact with an outside surface of the flexible membrane.

41. The apparatus of claim 40 wherein the control mechanism includes a program for automatically controlling the temperature of the expresser fluid.

10 42. The apparatus of claim 40 wherein the flexible membrane comprises an elastomeric sheet material.

43. The apparatus of claim 40 wherein the expresser fluid has a density selected to be greater
15 than the density of each of the selected one or more fluid materials disposed in the container.

44. The apparatus of claim 40 wherein the fluid container has a first radius and the second fluid sealed chamber has a second radius which is at least equal to the first radius of the fluid container, wherein the expresser fluid pumped into the second fluid sealed chamber travels to a circumferential
20 position within the second fluid sealed chamber which is more radially outward from the central axis than a circumferential position to which the one or more selected fluid materials in the fluid container travel when the rotor is drivably rotated around the central axis.

45. In a centrifuge apparatus comprising a rotor having a centrifuge chamber which is controllably rotatable around a central axis, a method for expressing one or more selected fluid materials each having a selected density out of a fluid container which contains the selected fluid materials wherein the fluid container comprises a round enclosure having a radius, a rotation axis, a flexible wall and an exit port sealably communicating with the fluid container for enabling the selected fluid materials contained therein to be expressed out of the fluid container through the exit port, the method comprising:

forming a round expandable enclosure within the centrifuge chamber wherein the expandable enclosure has a flexible wall, a radius and a rotation axis coincident with the central axis of the rotor;

mounting the fluid container coaxially within the centrifuge chamber such that the flexible wall of the fluid container faces the flexible wall of the expandable enclosure;

selecting an expresser fluid having a density greater than the density of each of the selected fluid materials;

pumping the selected expresser fluid into the expandable enclosure in an amount sufficient to expand the expandable enclosure such that the flexible wall of the expandable enclosure contacts the flexible wall of the fluid container; and,

drivably rotating the rotor around the central axis before, during or after the step of pumping.

46. The method of claim 45 further comprising placing the expresser fluid at one or more selected temperatures prior to or during the step of pumping.

47. The method of claim 45 wherein the radius of the expandable enclosure is selected to be at least equal to the radius of the fluid container.

48. Apparatus of claim 1 further comprising a temperature sensor connected to a program, wherein the temperature of the fluid materials is sensed by the temperature sensor, the program being
5 connected to a temperature mechanism which controls the temperature of the expresser fluid.